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ABSTRACT

This report is part of a general study of Reference Measures for Cognitive and Noncognitive Factors. The main activity being reported is the development of "factor-referenced" or "marker" tests for several recently identified cognitive factors. A secondary activity involves the study of possible relationships to factors already established. These developmental activities include a field study of these measures for improvement of the items in the tests, the determination of the reliabilities of the tests, and some clarification of these cognitive factors. The five newly identified factors are: concept attainment, figural fluency, integrative processes, visual memory, and verbal closure. Because it seemed especially important to determine whether the new factors could be separated from other somewhat similar factors, marker tests for six other factors were included in the study. These established factors are figural adaptive flexibility, logical reasoning, general reasoning, number facility, spatial orientation, and speed of closure. The results indicated that the attempt to find the verbal closure and figural fluency factors had been successful, that the visual memory factor had been adequately replicated, that there was confusion between the integrative processes factor and some of the reasoning factors, and that the attempt to replicate the concept attainment factor had failed. (Author)

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PR-75-17

AN ATTEMPT TO CONFIRM FIVE RECENTLY IDENTIFIED COGNITIVE FACTORS

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Ruth B. Ekstrom, John W. French,
and Harry H. Harman

June 1975

Technical Report No. 8

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NR 150 329

Harry H. Harman
Principal Investigator

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Educational Testing Service
Princeton, New Jersey

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This report is part of a general study of Reference Measures for Cognitive and Noncognitive Factors. The main activity being reported is the development of "factor-referenced" or "marker" tests for several recently identified cognitive factors. A secondary activity involves the study of possible relationships to factors already established. These developmental activities include a field study of these measures for improvement of the items in the tests, the determination of the reliabilities of the tests, and some clarification of

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The five newly identified factors are: concept attainment, figural fluency, integrative processes, visual memory, and verbal closure. Because it seemed especially important to determine whether the new factors could be separated from other somewhat similar factors, marker tests for six other factors were included in the study. These established factors are figural adaptive flexibility, logical reasoning, general reasoning, number facility, spatial orientation, and speed of closure.

The results indicate that the attempt to find the verbal closure and figural fluency factors had been successful, that the visual memory factor had been adequately replicated, that there was confusion between the integrative processes factor and some of the reasoning factors, and that the attempt to replicate the concept attainment factor had failed.

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An Attempt to Confirm Five Recently Identified Cognitive Factors

Ruth B. Ekstrom, John W. French, and Harry H. Harman

Introduction

This report is part of a general study of Reference Measures for Cognitive and Noncognitive Factors. The main activity being reported is the development of "factor-referenced" or "marker" tests for several recently identified cognitive factors. A secondary activity involves the study of possible relationships to factors already established. These developmental activities include a field study of these measures for improvement of the items in the tests, the determination of the reliabilities of the tests, and some clarification of these cognitive factors.

A review of the psychological literature of the past decade (Ekstrom, 1973) indicated that five cognitive factors, not included in previous kits of Reference Tests, might be sufficiently well-established to be included in a new edition of this Kit. Our standard for an "established factor" requires that the factor has appeared in a minimum of three studies done by at least two different researchers or laboratories. The five newly identified factors are: concept attainment, figural fluency, integrative processes, visual memory, and verbal closure.

Literature relevant to each factor was reviewed in order to develop definitions of the factors and hypotheses about the types of tests that would be useful as markers. Because it seemed especially important to determine whether the new factors could be separated from other somewhat similar factors, marker tests for six other factors were included in the study. These established factors are figural adaptive flexibility, logical reasoning, general reasoning, number, spatial orientation, and speed of closure.

Factors and Proposed Reference Tests

In this section a brief description of each factor is presented along with reference to the literature that substantiates it. Then the marker tests developed or selected for this factor are listed. The 11 factors are numbered according to their alphabetical position in a complete listing of cognitive factors, and the several factor-referenced tests are given serial numbers following the two-digit factor number. Thus test 142 is the second test (Building Memory) intended to mark Factor 14 (Visual Memory). The factor and test numbers are not sequential because this study did not include all of the established factors proposed for inclusion in the revised Kit and because not all of the tests for the established factors are included in this study. For ready reference, the 11 factors studied are as follows:

No.	Symbol	Factor Name
01	CA	Concept Attainment
03	CS	Closure, Speed of
04	CV	Closure, Verbal
07	FF	Fluency, Figural
11	IP	Integrative Processes
14	MV	Memory, Visual
15	N	Number
18	RG	Reasoning, General
20	RL	Reasoning, Logical
21	S	Spatial Orientation
26	XF	Flexibility, Figural

Three tests were developed or selected as markers for each of these factors. The newly developed tests were modeled after those described in the relevant literature. In addition, an effort was made to have the three tests for each factor be as different from each other as possible within the constraints of trying to measure the single hypothetical construct. This decision gave us more confidence that, if a factor separated successfully, the selected markers would fully define all aspects of the factor. However, it also increased the likelihood that factors might overlap or split up.

01 Concept Attainment Factor (CA) -- This factor is defined as the ability to formulate hypotheses about relationships among stimuli and to select the one hypothesis which best fits the evidence. Concept formation was first found as a separate factor by Adkins and Lyerly (1952). A similar factor, first called "abstration naming" and later called "convergent production of semantic units", was found in Guilford's laboratory (Guilford et al., 1952; Guilford, Kettner, and Christensen, 1956; O'Sullivan, Guilford, and de Mille, 1965; and Dunham et al, 1966). Several of Gulliksen's students (Allison, 1960; Bunderson, 1967; Duncanson, 1966; Manley, 1965) have studied the relationship of concept learning to abilities. Other studies including concept attainment or concept learning factors are Lemke et al. (1967) and Dunham et al. (1968).

Tests that were found to load on this factor required the subjects to uncover groups or relationships among stimuli and also the ability to name or otherwise identify the relevant aspect of these groups. The tests developed are:

011 - Finding Number Groups. In rows of numbers, the subject is asked to find and mark two groups of four consecutive numbers which have some similarity or relationship. Hypotheses about the groups may be checked against a "no group" row. 7 minutes for each of two parts.

012 - Figure Group Naming. For each item, the subject is asked to describe how one group of three complex figures differs from another group of figures. 7 minutes for each of two parts.

013 - Recognizing Word Groups. Each item askes the subject to decide whether or not a list of five words are conceptually related. 4 minutes for each of two parts.

03 Speed of Closure Factor (CS) -- This factor is defined as "the ability to unite an apparently disparate perceptual field into a single percept." It is a well-established factor that appeared in the 1963 Kit.

While Gestalt Completion type tests have been consistently good markers for this factor, there has been difficulty in finding other paper-and-pencil tests for this factor. A major concern was that the Concealed Words test, which had been included as a marker for the speed of closure in the 1963 Kit, might be a better marker for the verbal closure factor. In addition to these two tests from the 1963 Kit, the third test in the following list was newly developed for this factor:

031 - Gestalt Completion Test. The subject is asked to identify objects from silhouette-like pictures when parts of the picture have been erased. 3 minutes for each of two parts.

032 - Concealed Words Test. The subject is asked to identify common words when parts of each letter in the word have been erased. 4 minutes for each of two parts.

033 - Snowy Pictures. The subject is asked to identify objects which are partly obliterated by snow-like spatters. 4 minutes for each of two parts.

04 Verbal Closure Factor (CV) -- This factor is defined as "the ability to solve problems requiring the identification of words when some of the letters are missing, disarranged, or mixed with other letters." The verbal closure factor was first found by Pemberton (1952) and by Mooney (1954). More recently, verbal closure factors have appeared in studies by Adcock and Webberley (1971), Harris and Harris (1973), Messick and French (1967) and, somewhat less clearly in Guilford's laboratory as cognition of

symbolic units (Gershon et al., 1963; Hoepfner et al., 1964; Hoepfner and Guilford, 1965; Tenopyr et al., 1966; and Hoepfner et al., 1968). Verbal closure seems to be related to the cloze technique (Carver et al., 1971; Ohnmaht et al., 1970; Weaver and Kingston, 1963).

Tests that have been found to load on this factor include the rearrangement of the letters of one word to form another, filling in letters missing from common words, and locating short words embedded in a line of letters. The tests developed for this factor are:

041 - Scrambled Words. For each item, the subject is asked to select from an array of letters the one letter which will begin a common word when all of the letters shown are rearranged. 5 minutes for each of two parts.

043 - Hidden Words. The subject is asked to find and circle one or more four-letter words in apparently random lines of letters. 4 minutes for each of two parts.

044 - Incomplete Words. The subject is asked to provide one or more letters to complete common words. 3 minutes for each of two parts.

07 Figural Fluency Factor (FF) -- This factor is defined as "the ability to produce a response quickly by drawing a number of examples, elaborations, or restructurings based on a given visual or descriptive stimulus." Figural fluency factors have appeared in several studies (Bereiter, 1960; Gershon et al., 1963; Hoepfner and Guilford, 1965; Hoffman et al., 1968; and Cave, 1970).

Tests that have been found to load on this factor require the subject to elaborate on a given figure, to produce a number of figures in response to

given stimuli, or to produce as many different figures as possible from a limited number of elements. The tests developed for this factor are:

071 - Ornamentation Test. The subject is asked to make as many different decorations as possible on common objects. 2 minutes for each of two parts.

072 - Elaboration Test. The subject is asked to add to the existing decoration on objects as many different additions as possible. 3 minutes for each of two parts.

073 - Symbols Test. The subject is asked to draw up to five different symbols for each of several words or phrases. 5 minutes for one part.

11 Integrative Processes Factor (IP) -- This factor is defined as "the ability to keep in mind simultaneously or to combine several conditions, premises, or rules in order to produce a correct response." This factor first appeared in the Army Air Forces study (Guilford and Lacey, 1947) and has also been identified in studies by Lucas and French (1953) and by Traub (1970).

Tests that have been found to load on this factor have required the subject to follow a fairly complex set of directions or to handle a set of complex rules. The tests developed for this factor are:

111 - Calendar Test. The subject is asked to select certain dates on a calendar by following fairly complex directions. 5 minutes for each of two parts.

112 - Following Directions. The subject is asked to determine the point in a matrix of letters that would be reached by following a complex set of directions. 7 minutes for each of two parts.

113 - Language Rules. The subject is asked to make translations from English into an artificial language by following a series of complex rules. 8 minutes for each of two parts.

14 Visual Memory Factor (MV) -- This factor is defined as "the ability to remember the configuration, location and orientation of figural material." This factor was first identified when Humphreys and Fruchter (1945) reanalyzed a study by Carlson (1937). It has appeared in several of the Army Air Force studies (Guilford and Lacey, 1947) and in later studies by Guilford, Fruchter, and Zimmerman (1952), Roff (1951, 1953), Christal (1958), and Bradley et al. (1969).

Tests that have been found to load on this factor have required the subject to recognize the position or orientation of simple figures studied earlier, to sketch arrangements of letters studied earlier, to recall the location of buildings on a previously studied map, to select from a group of maps the ones which had been previously studied, and to recall the sequence of items which had been seen on a study page. The tests developed for this factor are:

141 - Shape Memory Test. The subject is asked to identify those irregular forms which were previously seen in the same orientation on a study page. Two parts each requiring 4 minutes for a study page and 4 minutes for a test page.

142 - Building Memory. The subject is asked to indicate the location of a number of buildings on a previously studied map. Two parts each requiring 4 minutes for a study page and 4 minutes for a test page.

143 - Map Memory. The subject is asked to identify those maps which were previously presented on a study page. Two parts each requiring 4 minutes for a study page and 3 minutes for a test page.

15 Number Factor (N) -- This factor had formerly been defined as "the ability to perform basic arithmetic operations with speed and accuracy." It is a well-established factor that appeared in the 1963 Kit. However, the literature suggests that this factor may be broader than simple arithmetic manipulation. For example, non-numerical coding tasks have also been found to load on this factor. In the following list, the first test is from the 1963 Kit and two were newly developed for this factor:

153 - Subtraction and Multiplication Test. The subject is asked to make simple subtraction and multiplication computations as rapidly as possible. 2 minutes for one part.

154 - Alphabet Distance Speed. The subject is asked to count, as rapidly as possible, the number of letters intervening in the alphabet between pairs of letters presented. 2 minutes for each of two parts.

155 - Addition and Subtraction Correction. The subject is asked to indicate whether the answer shown for simple addition and subtraction problems is correct or incorrect. 2 minutes for each of two parts.

18 General Reasoning Factor (RG) -- This factor is defined in the 1963 Kit as "the ability to solve a broad range of reasoning problems including those of a mathematical nature." It is a well-established factor that appeared in the 1963 Kit. There has been a good deal of difficulty differentiating

between this factor and other kinds of reasoning as well as between this factor and numerical ability.

Tests loading on this factor have required the subject to solve verbally presented problems requiring arithmetic and/or simple algebra, to compute from several pieces of data the effective distance of a ship from a port, and to determine the type and sequence of numerical operations necessary to solve verbally presented problems. Tests 181 and 184 are from the 1963 Kit and test 183 was newly developed for this factor:

181 - Mathematics Aptitude Test. The subject is asked to select the correct answer for verbally presented problems requiring fairly simple arithmetic reasoning. 10 minutes for one part.

183 - Deciphering Languages. The subject is asked to use reasoning to determine the English translation of artificial languages. 8 minutes for each of two parts.

184 - Necessary Arithmetic Operations. The subject is asked to determine what numerical operations are necessary to solve arithmetic problems without actually carrying out the computations. 5 minutes for one part.

20 Logical Reasoning Factor (RL) -- This factor, called syllogistic reasoning in the 1963 Kit, is defined as "the ability to reason from stated premises to their necessary conclusions."

Tests that have loaded on this factor have required the subject to determine if a conclusion follows logically from given premises, to select the conclusion that can be correctly drawn from given premises, and to select the conclusion that can be validly drawn from earlier statements.

The first of the following three tests comes from the 1963 Kit and the other two have been newly developed for this factor:

201 - Nonsense Syllogisms Test. For each item, the subject is asked to decide whether or not a stated conclusion follows correctly from the premises. 4 minutes for one part.

202 - Diagramming Relationships. The subject is asked to select the diagram which best illustrates the interrelationship among sets of three objects. 4 minutes for each of two parts.

204 - Letter Group Reasoning. For each item, the subject is asked to determine whether the conclusions drawn about the relationships among three groups of letters is true or false. 5 minutes for each of two parts.

21 Spatial Orientation Factor (S) -- This factor is defined as "the ability to perceive spatial patterns or to maintain orientation with respect to objects in space." It is a well-established factor that appeared in the 1963 Kit.

Tests that have been markers for this factor have required the subject to determine whether two-dimentional figures have been simply rotated or flipped over as well, to determine whether or not a pair of three-dimensional figures could be different views of the same object, and to select the correct new position for the prow of a boat given the motion indicated in two pictures. The first two tests are from the 1963 Kit while the third one was developed for this factor:

211 - Card Rotations Test. For each row in the test the subject must decide if each of eight drawings

is or is not a simple rotation of the sample figure. 4 minutes for one part.

212 - Cube Comparison Test. The subject is asked to indicate which items show a pair of drawings representing different views of the same alphabet block cube. 3 minutes for one part.

213 - Spatial Aspects Test. Each item asks the subject to indicate how his orientation has changed in relation to an object pictured in two different positions. 4 minutes for each of two parts.

26 Figural Flexibility Factor (XF) -- This factor is defined in the 1963 Kit as "the ability to change set in order to meet new requirements imposed by figural problems. The evidence for the establishment of this factor was given in a report of an earlier phase of the present research (Ekstrom, French, and Harman, 1974, p. 7).

Tests that have loaded on this factor have required the subject to indicate how different patterns can be made of a specified number of squares or triangles when a certain number of matches have been removed; and to select the most direct path for skywriting pairs of letters. The tests newly developed for this factor are:

261 - Toothpicks Test. The subject is asked to present up to six different arrangements of toothpicks according to sets of specified rules. 5 minutes for one part.

262 - Drawing Assembly. The subject is asked to use a limited number of figural elements in as many different arrangements as possible. 4 minutes for each of two parts.

263 - Storage Test. The subject is asked to show how many different ways small boxes can be arranged inside of a larger container. 3 minutes for one part.

Subjects and Experimental Design

The study sample consists of a total in excess of 2,500 male Naval recruits processed through the Navy Training Center at San Diego, California in the spring of 1974. It should be noted that these subjects were all volunteer recruits and therefore do not represent a random sample of young adult males. While no formal data on educational level were collected, the general impression obtained that only about half of the subjects had completed secondary school. This is below the average level of educational attainment for this age group. Because of the possibility that the men might have been assigned to companies by some measures of ability, we tried to cut across companies as much as possible for the determination of test statistics. Also, the size of the test battery was so large that not all tests could be administered to all subjects. Thus, a total of at least 500 men took each test to provide meaningful item statistics and test reliability.

To get the correlations among all 33 tests required a rather complex experimental design. The most expedient approach was to adapt a 21 x 29 experimental design that had been worked out formally in the statistical literature. The tests for the 11 putative factors were grouped into 21 "elements" to reduce the variance in testing time of the 29 sessions. Each of these "elements" (consisting of one, two, or three tests) was administered in 6 different testing sessions except for one element that was given only 5 times. That is how large N's were obtained for overall item and test statistics. However, for a correlation between two tests, the N was limited

to the cases taking the pair of tests in a given session. These numbers range from 80 to 98. A compact summary of this experimental design, including the detailed test administration schedule, is shown in Table 1.

Psychometric Properties of the Tests

The tests were scored according to criteria developed by the authors. A condensed set of test directions, including illustrative items, appears in the Appendix. Each score was checked at least once and discrepancies were resolved by the supervisor.[1]

An item analysis was made for 17 of the tests. Such analysis was not appropriate for some tests, either because the items were free responses or because they were so homogeneous as to make it meaningless. Some summary item statistics are presented in the left-hand block of Table 2, after the test number and the number of cases and number of items in the test. The item analysis includes the difficulty of each item (actually, percent answering item correctly) and the item-test biserial correlation. To present the individual item statistics would require too much space, so the range of values for all items in a test and the median value are recorded for both the item difficulties and item-test biserials. In general, items that correlate less than .40 with total test score are not sufficiently valid for inclusion in the marker test. Four of the 17 tests had no items that correlated less than .40 with total test score; these are Figure Group Naming, Gestalt Completion, Language Rules, and Building Memory. Of course, it would be better if all the tests had this property. While there are individual

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[1]The authors express their thanks to Doris Conway for supervising the test scoring.

Table 1

Experimental Design

Test Elements	Testing Session																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
142	X	X	X	X	X	X																							
181, 184	X						X	X	X	X	X																		
012	X											X	X	X	X	X												
141	X																X	X	X	X	X								
261-3		X					X					X					X					X				X		
043, 044		X						X						X						X						X		X	
031, 032		X							X							X		X							X			X
041			X					X					X					X					X				X		
071-3			X						X						X						X	X					X		
112			X							X		X							X						X			X	
113				X					X					X					X					X			X		
033				X						X						X	X						X				X		
211-3				X							X		X							X		X						X	
143					X					X					X					X				X		X			
183					X						X	X						X					X				X		
111					X		X							X							X		X					X	
013						X					X					X					X				X	X			
153-5						X	X						X						X					X			X		
201, 202						X		X							X		X							X				X	
204	X																					X	X	X	X	X			
011		X								X			X								X			X					
Time (Min.)	61	66	51	51	50	42	51	51	60	59	54	56	55	50	49	40	50	54	54	55	57	56	38	64	46	46	62	63	65

Table 2

Item and Test Statistics

Test Number	Number of Cases	Item Analysis					Test Analysis			
		Number	Difficulties		r_{bis}		Test Score		Reliability	
			Md	Range	Md	Range	M	S.D.	r	α
011	460	20	.35	.01-.72	.56	.17-.70	5.25	2.84	.59	.56
2	558	20	.34	.07-.95	.58	.43-.70	6.90	2.83	.59	.62
3	567	48	.80	.10-.97	.58	.20-.81	30.60	7.91	.81	.90
031	544	20	.85	.20-.99	.80	.58- **	15.24	3.65	.79	.85
2	544	50*	.60	.01-.99	.52	.12-.94	23.57	6.44	.73	.83
3	562	24	.21	.01-.90	.56	.09-.73	5.67	3.03	.65	.68
041	553	50					27.05	9.92	.33	
3	563	114					53.98	16.87	.84	
4	563	100					25.47	18.61	.85	
071	542	48					21.94	10.00	.85	
2	545	40					24.21	8.96	.86	
3	546	5†					9.06	3.76	***	
111	574	20	.57	.27-.90	.65	.06-.86	8.84	3.84	.77	.75
2	562	20	.60	.11-.93	.61	.17-.78	10.39	3.79	.79	.76
3	558	30	.66	.35-.86	.71	.59-.80	17.22	7.48	.80	.92
141	562	32	.70	.26-.86	.44	.17-.57	21.40	4.28	.53	.68
2	564	24*	.45	.24-.89	.57	.42-.71	10.90	4.73	.69	.80
3	563	24*	.76	.47-.89	.58	.27-.77	17.12	3.90	.71	.77
153	563	60					19.30	9.13	***	
4	562	120					20.73	12.73	.88	
5	563	120					42.72	14.29	.86	
181	544	15					4.56	3.63	***	
3	570	24	.21	.06-.90	.60	.22-.85	8.78	3.04	.51	.69
4	544	15					4.80	3.09	***	
201	557	15*	.51	.17-.84	.46	.30-.61	6.45	2.12	***	.38
2	557	30*	.38	.16-.83	.49	.34-.78	12.13	5.21	.74	.79
4	541	48	.85	.14-.99	.54	.14- **	36.80	7.09	.51	.90
211	550	10†					43.96	24.60	***	
2	550	21					5.18	5.11	***	
3	551	40	.29	.03-.56	.52	.04-.82	7.87	5.46	.68	.78
261	551	5†					4.11	2.62	***	
2	549	2†					5.03	3.27	.60	
3	551	1†					2.02	2.55	***	

*One item not scored.

†Indicated is the number of stimuli; score is the total number of correct responses to these stimuli.

**Exceeds 1.00. Could be caused by failure of the item to satisfy the assumption of normal distribution of the underlying trait, or because the total test scores tend toward platykurtic distribution (see McNemar, 1955, p. 197).

***Only one part of the test was administered.

items with poor biserials, at least the median biserial is well above this threshold for all the tests.

In the right-hand block of Table 2 some summary test statistics are shown. The mean and standard deviation is given for the total scores for each test. Two measures of reliability are shown in the last two columns of Table 2. First, for those tests that were administered in two parts, the split-half correlation r_{12} between part 1 and part 2 was computed and adjusted to double length by the Spearman-Brown correction,

$$r = \frac{2r_{12}}{1 + r_{12}} .$$

This is the reliability of scores based on the whole test that is given in the table. The second index of reliability is available for the 17 tests that were item-analyzed. This is the coefficient α, given by

$$\alpha = \frac{n}{n-1} \left(1 - \sum_{i=1}^{n} V_i / V_t\right)$$

where n = number of items in test t,

V_i = variance of item i,

V_t = variance of test t.

Except for Test 201 (Nonsense Syllogisms) the reliabilities of the tests range from fair to excellent with most of them well in excess of .70.

It became apparent from an inspection of the data in Table 2 that a number of the tests were probably too difficult for this population. On the other hand, the median difficulties for the tests that were item-analyzed indicate that some of them are quite easy. These tests were designed to be used with subjects of both high school and college age. A fairly large

proportion of the subjects, according to our information, had not completed high school.

Factor Analyses

The intercorrelations among the tests are shown in Table 3 (upper triangle). Each correlation is based on the maximum number of cases taking the particular pair of tests. The number of cases on which the coefficient is computed varies from cell to cell according to the experimental design shown in Table 1, and is recorded in the lower triangle of Table 3. Thus, since two of the General Reasoning tests (181 and 184) were treated as a single element in the design and were always administered together, their correlation (.63) was based on a large N (=544) while the correlations of each of these tests with all the other tests were based on N's only in the mid 80's to high 90's. Similarly, large N's were involved in the correlations among the sets of three tests designed to mark the following factors: Figural Fluency (07), Number (15), Spatial Orientation (21), and Figural Flexibility (26). Three other pairs of tests had large N's. While it is somewhat unfortunate not to be able to give a large battery of tests to a single, large sample, the compromise followed in this study appears to be quite satisfactory.

The Minres method was used to obtain direct factor analyses without using prior knowledge about the substantive aspect of the study for hypothesizing the number of factors. Instead we used the popular criterion of the number of principal components with roots greater than one. This leads to eleven common factors--fortuitously matching the precise number of factors designed in the experiment. It should be noted that because the experimental design led to a slightly improper correlation matrix, the last four roots became negative despite the fact that unities had been used in the diagonal.

Table 3

Intercorrelations of Tests*

Test	011	012	013	031	032	033	041	043	044	071	072	073	111	112	113	141	142	143	153	154	155	181	183	184	201	202	204	211	212	213	261	262	263
CA 011		37	-02	21	31	31	21	17	26	22	26	05	15	39	21	-00	16	17	15	34	32	39	01	30	-10	13	16	31	31	24	14	22	22
2	86		33	16	13	23	27	13	32	23	14	31	44	31	42	08	24	26	14	39	50	46	40	25	36	41	21	35	47	41	19	29	25
3	93	88		12	-05	04	46	41	27	-02	11	21	18	42	28	-06	20	-06	18	41	35	40	21	35	19	32	24	36	26	30	35	28	20
CS 031	86	87	89		26	32	-08	-09	14	-12	-11	13	28	15	-03	14	03	27	-04	13	12	-04	03	-05	27	27	23	36	24	29	-03	08	13
2	87	87	89	531		19	41	17	39	26	14	23	29	16	32	06	26	-14	28	09	20	32	03	21	18	28	30	15	10	03	18	24	14
3	86	85	87	87	86		29	02	-13	-08	02	19	26	19	39	22	38	35	-22	01	-15	20	15	01	08	16	15	19	39	21	10	11	05
CV 041	91	86	93	94	93	94		47	60	17	24	15	39	45	28	-01	28	04	32	24	43	18	-06	34	04	21	19	40	22	32	28	30	34
3	89	94	97	87	88	97	88		47	34	23	29	31	40	31	18	12	19	48	24	50	23	08	17	-04	19	28	22	37	28	12	13	07
4	89	94	97	87	88	97	88	563		30	09	32	35	41	52	08	14	14	46	33	56	20	24	24	15	24	26	15	20	44	19	07	14
FF 071	93	92	97	87	85	97	92	97	97		71	39	05	22	14	17	13	08	29	02	21	14	-01	18	06	23	-03	-23	-22	-06	13	10	-14
2	93	92	97	87	85	97	92	97	97	545		39	04	16	10	09	11	09	16	14	04	15	-04	19	03	21	-03	-15	-16	-07	19	28	-25
3	93	91	97	87	85	97	91	97	97	543	545		-09	10	21	-04	09	-13	11	19	16	28	24	19	12	30	-02	-22	-17	-15	06	34	-12
IP 111	93	93	97	90	90	94	95	94	94	97	97	97		54	53	07	36	23	53	60	68	75	35	69	15	38	60	32	39	40	15	47	45
2	86	94	97	91	91	88	92	97	97	92	92	91	92		68	12	29	25	45	41	52	65	27	34	07	41	51	33	38	29	27	42	40
3	87	90	89	85	83	95	88	90	90	85	85	85	90	92		25	29	02	55	53	59	75	24	57	26	43	46	43	27	34	35	37	26
MV 141	92	87	96	92	91	92	92	95	95	96	96	96	96	93	92		40	38	03	23	13	41	28	41	-02	-05	21	30	25	37	21	-01	03
2	83	87	90	81	82	85	92	84	84	92	92	91	97	92	86	89		47	18	26	23	37	20	31	22	22	27	12	29	23	20	17	24
3	87	91	94	88	88	89	93	96	96	94	94	93	96	89	89	95	96		-10	22	01	44	11	21	04	21	02	35	18	38	02	22	28
N 153	91	86	94	83	89	97	91	97	97	97	97	97	97	93	92	93	92	88		33	69	48	12	50	07	20	25	08	-04	02	22	28	11
4	91	86	94	88	88	97	91	97	97	97	97	97	97	93	92	93	92	87	562		46	56	19	56	15	47	29	16	25	25	25	29	32
5	91	86	94	89	89	97	91	97	97	97	97	97	97	93	92	93	92	88	563	562		63	21	61	07	43	39	34	36	24	25	31	27
RG 181	87	87	93	87	85	89	88	88	88	87	87	87	97	89	85	89	89	90	97	97	97		49	63	13	50	48	40	42	40	15	32	44
3	89	93	93	92	91	96	92	96	96	96	96	96	97	95	89	90	96	96	96	96	96	93		30	47	50	38	21	32	41	07	17	27
4	87	87	93	87	85	89	88	88	88	87	87	87	97	89	85	89	89	90	97	97	97	544	93		16	54	28	32	16	29	28	43	39
RL 201	89	92	94	90	90	93	87	87	87	95	95	94	91	92	89	92	92	94	96	96	96	87	91	87		30	17	15	16	20	-17	-06	09
2	87	92	93	89	89	92	88	88	88	95	95	94	90	91	86	91	91	94	95	95	95	88	88	88	547		38	26	19	32	06	-00	15
4	88	87	85	87	87	83	84	85	85	76	78	79	84	85	88	89	89	87	87	86	87	89	90	89	90	87		36	26	33	16	21	08
S 211	91	86	93	91	91	95	91	96	96	77	79	80	92	93	96	95	86	96	91	91	91	93	93	93	92	91	79		42	40	21	17	22
2	91	86	93	91	91	96	91	96	96	77	79	80	92	93	96	95	86	96	91	91	91	93	93	93	92	91	79	549		37	01	10	13
3	87	82	91	83	82	89	87	68	68	74	76	77	83	84	88	67	78	68	87	87	87	91	91	91	83	82	76	496	496		07	11	40
XF 261	89	94	94	87	88	93	93	90	90	77	79	80	97	97	89	92	84	94	97	97	97	97	95	97	93	92	79	80	80	77		19	24
2	89	94	94	87	88	93	93	90	90	76	78	79	97	97	89	92	84	94	97	97	97	97	95	97	93	92	79	79	79	76	550		15
3	89	94	94	87	88	93	93	90	90	77	79	80	97	97	89	92	84	94	97	97	97	97	95	97	93	92	79	80	80	77	551	550	

*The correlation coefficients (with decimal point understood to precede each number) appear in the upper triangle; the number of cases on which each correlation is based is shown in the lower triangle.

The plot of the roots is shown in Figure 1. Thus, the number of factors obtained by this method is probably an over-estimate. For preliminary interpretive purposes, the eleven factors were rotated to orthogonal final factors by varimax and to oblique final factors by the direct oblimin and orthoblique methods.

The orthogonal 11 factor solution is shown in Table 4 and the oblique factor pattern is presented in Table 5. It should be immediately evident from the number of instances of a factor being identified by a single test that too many "factors" have been extracted. Consequently, six, seven, and eight-factor solutions were then computed. Only the six factor solution, shown in Table 6, did not produce Heywood cases. An additional analysis was also made using the Harris-Kaiser (1964) proportional solutions for six factors in hopes of substantiating some of the putative factors. The results are shown in Table 7. However, none of these solutions were very satisfactory insofar as clearly identifying and delineating the several factors that had been hypothesized. While the new factors of "figural flexibility," "verbal closure," and "visual memory" appeared fairly clearly, the "integrative processes" factor seemed inextricably intermingled with "numerical facility" and also with both "general" and "logical reasoning."

Since one of the purposes of this study was to see how closely the obtained factors using the newly developed tests would match the intended factor structure, it was decided to obtain the best-fitting orthogonal and oblique factor solutions to the desired targets--namely, large weights for the three tests intended as markers for a particular factor and zeros for all other weights. As can be seen from Tables 8 and 9, the resulting

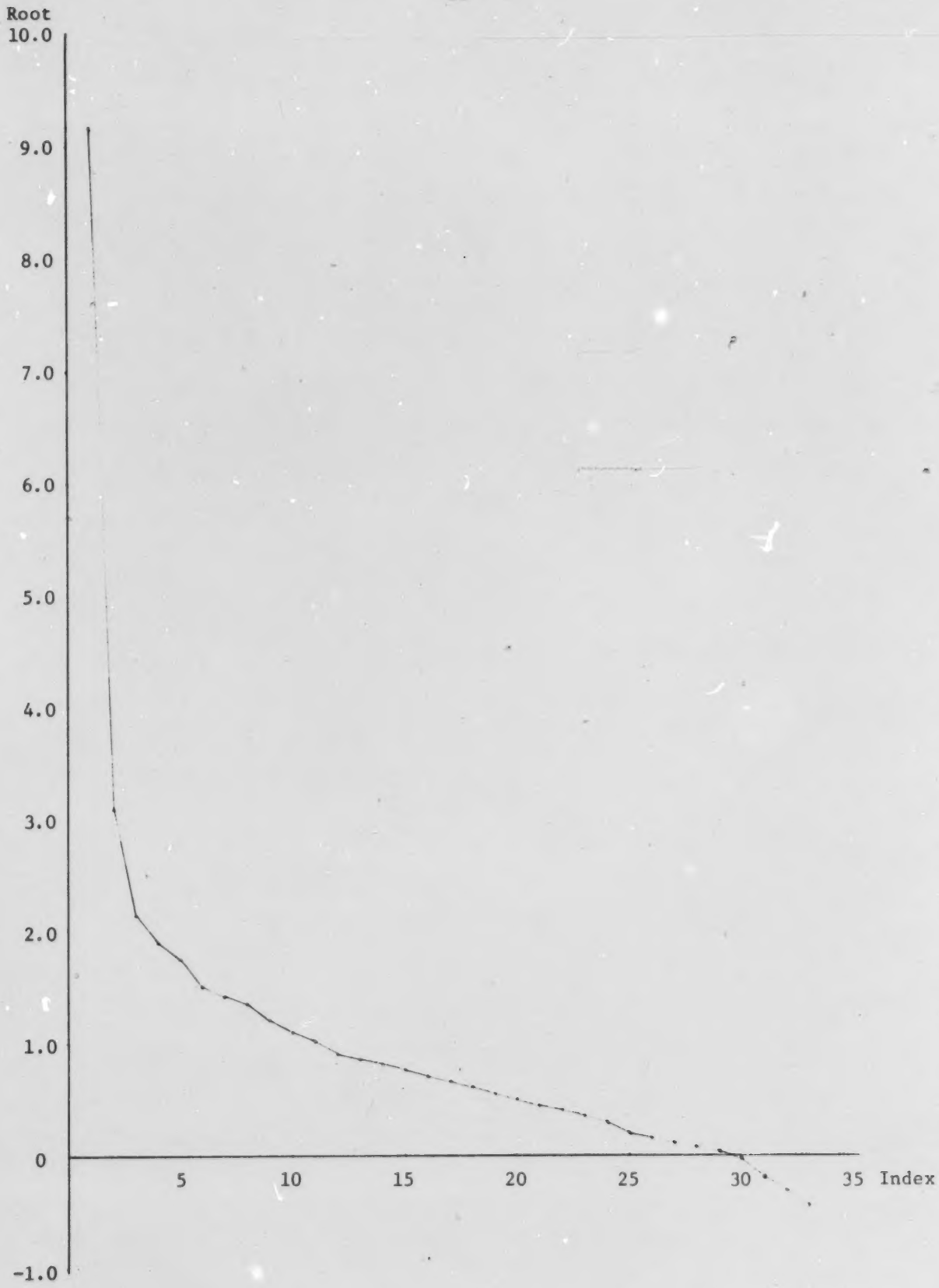

Figure 1--Characteristic roots of correlation matrix

Table 4

Varimax Solution: 11 Factors
(Loadings .30 or greater)

Test	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	h^2
011										.93		1.00
2		.50								.34		.55
3								.91				1.00
031											.96	1.00
2				.47								.55
3					.96							.99
041				.84				.34				1.00
3							.74					.74
4				.58			.42					.74
071			.80									.75
2			.76									.63
3			.65									.59
111	.89											.99
2	.59											.58
3	.68								.96			.74
141												1.00
2					.30							.38
3						.94						1.00
153	.68											.70
4	.56											.48
5	.71						.35					.79
181		.34										.92
3		.73										.63
4	.72											.75
201		.63										.44
2	.37	.54										.52
4	.48											.45
211			-.33				.44					.52
2			-.32		.31							.62
3		.40				.34						.58
261								.32				.31
2	.47											.37
3	.36					.32						.51
Total	5.58	2.43	2.36	1.83	1.65	1.64	1.58	1.55	1.48	1.46	1.29	22.84

Table 5

Direct Oblimin Factor Pattern: 11 Factors
(Coefficients .30 or greater)

Test	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
011									1.05		
2					.46				.36		
3						.99					
031										1.00	
2				.40							
3							.96				
041				.91							
3								.64			
4				.60							
071		.79									
2		.77									
3		.65									
111	.92										
2	.45										
3	.49										
141											1.02
2											
3			.94								
153	.72										
4	.36										
5	.59										
181	.58										
3					.75						
4	.46							-.33			.30
201					.64						
2					.50						
4											
211		-.34						.42	.30		
2		-.32									
3					.32						
261						.31					
2	.39										
3		-.32									

Factor	Factor Correlations										
I	1.00	.10	.07	.34	.28	.32	.08	.02	.37	-.05	.28
II		1.00	-.12	.12	-.02	.03	-.01	-.02	.05	.06	.01
III			1.00	.03	.13	.11	.12	-.01	.19	-.01	.19
IV				1.00	.12	.22	.05	.09	.28	-.10	.19
V					1.00	.18	.13	.09	.18	-.22	.17
VI						1.00	.10	.03	.26	-.01	.15
VII							1.00	-.04	.17	-.18	.07
VIII								1.00	.06	-.06	.07
IX									1.00	.14	.23
X										1.00	.03
XI											1.00

Table 6

Varimax Solution: 6 Factors
(Loadings .30 or greater)

Test	I	II	III	IV	V	VI	h^2
011						.32	.27
2			.47				.45
3	.30	.37					.29
031			.30			.34	.25
2						.31	.28
3						.87	.83
041		.70				.32	.69
3		.63					.49
4		.74					.67
071				.82			.77
2				.76			.62
3			.31	.62			.57
111	.78						.74
2	.59	.35					.55
3	.71						.65
141					.61		.40
2					.39		.32
3					.78		.65
153	.65	.34					.64
4	.58						.43
5	.69	.49					.76
181	.81		.31		.37		.90
3			.69				.57
4	.75						.66
201			.63				.40
2	.36		.58				.52
4	.44						.35
211		.30		-.36			.47
2				-.32		.31	.44
3		.38	.36		.48		.60
261	.32						.18
2	.48						.31
3	.37						.28
Total	5.54	2.82	2.40	2.32	2.12	1.82	17.02

Table 7

Orthoblique (Proportional) Factor Pattern: 6 Factors
(Coefficients .30 or greater)

Test	I	II	III	IV	V	VI
011						.30
2				.41		
3			.31			
031						.31
2						.32
3						.86
041			.64			
3			.61			
4			.72			
071		.81				
2		.75				
3		.60		.33		
111	.81					
2	.59					
3	.74					
141					.60	
2					.34	
3					.77	
153	.67					
4	.59					
5	.68		.36			
181	.85					
3				.66		
4	.79					
201				.66		
2	.34			.53		
4	.44					
211		-.41				
2		-.37				
3		-.31	.36		.41	
261	.33					
2	.51					
3	.38					

Factor	Factor Correlations					
I	1.00	.01	.33	.24	.17	.13
II		1.00	.06	-.05	-.08	-.03
III			1.00	.10	.04	.09
IV				1.00	.13	.12
V					1.00	.17
VI						1.00

Table 8

Orthogonal Procrustes Factor Solution: 11 Factors
(Loadings .30 or greater)

Test	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
011	.74	.40							-.39		
2	.50							.31	.31		
3	.30								.34	.52	.56
031		.67						-.33	.45		
2		.57	.31								
3		.59			.43		-.55				
041			.82								.46
3			.54	.34	.32					.33	
4			.70				.36				
071				.68							
2				.71							
3				.66							
111					.70		.42		.31		
2				.49	.49						
3					.47			.50			
141	-.32					.63		.39		.48	
2						.38					
3						.93					
153			.30		.37		.62				
4							.35				
5			.31		.36		.64				
181					.54			.56			
3								.53			
4							.43	.50			
201									.57		.43
2									.50		
4					.36					.31	
211										.50	
2					.34					.56	
3						.34				.37	
261											.40
2					.37						.34
3											.36

Table 9

Oblique Procrustes Factor Pattern: 11 Factors
(Coefficients .30 or greater)

Test	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
011	.87									.32	
2										.31	
3	-.53									.48	.47
031		.90						-.41			
2		.48	.30							-.31	
3		.55					-.66				
041			.93								.32
3			.57							.36	
4			.71								
071				.74							
2				.77							
3				.69							
111					.73						
2					.34						
3								.50			
141					-.32	.83		.39	-.30		
2						.38					
3						.84		-.31			
153					.33		.56				
4											.30
5							.57				
181					.40			.49			
3								.57	.44		
4								.44			.39
201									.52		
2									.41		
4											
211										.36	
2										.62	
3			.31								
261											.32
2											.32
3				-.32							.45

Factor	Factor Correlations										
I	1.00	.15	.16	.07	.19	.20	.07	.06	.03	.03	.09
II		1.00	.22	.02	.18	.16	.06	.27	.11	.22	.13
III			1.00	.18	.26	.11	.27	.29	.03	.17	.20
IV				1.00	.12	-.03	.10	.11	-.04	.04	.08
V					1.00	.19	.17	.28	.08	.18	.22
VI						1.00	.06	.16	.09	.17	.11
VII							1.00	.21	.09	.08	.13
VIII								1.00	.06	17	.12
IX									1.00	.13	.05
X										1.00	.21
XI											1.00

Procrustes rotations are much closer to the hypothesized factors--especially the oblique solution--but certainly not as clear-cut as one would expect if all the intended markers were truly effective.

Conclusions

On the basis of these solutions, it may be concluded that the attempt to find the verbal closure and figural fluency factors have been successful, that the visual memory factor has been adequately replicated, that there was confusion between the integrative processes factor and some of the reasoning factors, and that the attempt to replicate the concept attainment factor had failed completely.

As can be seen, a major problem in this analysis is the combining of the integrative processes, numerical facility, general reasoning, logical reasoning, and figural flexibility tests. The relationship among integrative processes, numerical reasoning, and general reasoning seems particularly strong. One possible explanation is that a lack of simple computational skills in this particular population made any test requiring such skills too difficult for most of the subjects.

On the basis of these data, it is recommended that the Concept Attainment factor not be included in the new edition of the Kit. Considerably more research is needed to understand how this and other learning processes relate to cognitive factors, and how to develop tests to tap such processes. It is possible that this ability and other aspects of information processing interact with perception, memory, and other basic cognitive processes to form part of the structure for a model of human intellectual ability.

The Verbal Closure and Speed of Closure factors separated much more readily than had been anticipated. It was thought that the verbal content of the Concealed Words test (032) might make it load with the tests of verbal closure. While this did occur in the 11 factor orthogonal solution, it was considerably less pronounced in the 11 factor targeted oblique solution and disappeared entirely in the six factor solution.

The Figural Fluency factor also proved to be very distinct. This is probably due in large part to its being quite different from most of the other factors since it requires divergent production of figural material. The other factor included in this battery with which Figural Fluency might have combined was Figural Flexibility. However, such a confounding did not occur in any of the factor analyses. This is probably because figural fluency is more nearly a projection of the current Ideational Fluency factor, which is semantic in content, into the figural realm and also because it requires only minor amounts of relatively trivial flexibility rather than the more major set-breaking required in Figural Flexibility.

The Integrative Processes factor, on the other hand, presents a number of problems. As already mentioned, this factor tends to combine with several of the other factors included in this study. Even in the targeted solutions, the data supporting this factor are weak. The Language Rules test (113), in particular, loads instead on the Logical Reasoning factor. A possible explanation of why Integrative Processes has a tendency to go with General Reasoning, especially why Language Rules does not go along with the other tests of the former factor, might be related to the amount of systematic relationships among the data being integrated. In both the Following Directions and the Calendar tests there are no

overwhelming relationships among the stimuli but the stimuli for the Language Rules test are much more systematic. If General Reasoning involves the ability to organize information systematically so as to use it in problem solving, then if any set of data to be integrated can be systematically organized it will load on General Reasoning as well as on Integrative Processes. The median item difficulties for all three tests intended to mark this factor are high enough to rule out difficulty as the underlying cause. If it were not for the fact that a test very similar to Language Rules has worked reasonably well in other studies, we would recommend that it be dropped as a marker for this factor. Under these circumstances we strongly recommend that Language Rules not be used as the sole marker in any study of integrative processes and caution users that there may be considerable variance on the General Reasoning factor.

The Visual Memory factor split into two, one for each of two tests in the set, when 11 factor solutions were tried, but was clearly distinct in the other solutions. The Building Memory test (142) is less satisfactory as a marker for this factor than are the Shape Memory and Map Memory tests (141 and 143, respectively). The Shape Memory test tends to show some variance on other factors in the two targeted solutions but not in the two six factor solutions.

Of the new tests tried out in this study as possible new and additional markers for established factors, Snowy Pictures, Addition and Subtraction Correction, and Diagramming Relationships seem to work well. Both Snowy Pictures and Diagramming Relationships, need to be simplified somewhat according to the median item difficulties but, given the relative

low level of educational attainment of our subjects, most of the tests were of appropriate difficulty. Deciphering Languages, which had been designed as a test of General Reasoning, appears to be a possible marker for Logical Reasoning instead since, except in the targeted solutions, it has its major loading on a factor which includes Nonsense Syllogisms and Diagramming Relationships. The Deciphering Languages test also needs to be made easier. The Alphabet Distance Speed, Letter Group Reasoning, and Spatial Aspects tests are not sufficiently strong to warrant their use as marker tests.

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APPENDIX

Test Directions

011 - FINDING NUMBER GROUPS

A scientist often faces a lot of data, usually numbers. He must look for some kind of sense or recurring patterns in those numbers. In each item here your task is to look at a row of 15 single-digit numbers and find two groups of four consecutive numbers that have some similarity. To test your theories about these groups, there is a row of 15 numbers in which there are no such groups.

When you find the two groups, circle them.

Sample item:

Two groups: 8 (3 4 5 6) 7 2 (5 6 7 8) 2 2 8 5

No group: 8 1 7 3 6 2 3 4 1 9 6 2 3 7 1

The two groups that are circled are groups of four numbers in sequential order.

Another sample item:

Two groups: 1 8 7 3 2 6 8 4 5 3 4 4 6 8 7

No group: 2 8 6 1 7 3 4 4 4 9 1 2 7 3 2

In this sample there are two groups of even numbers. No other two groups of four numbers makes any particular sense. You should have circled 2,6,8,4 and 4,4,6,8 in the line marked two groups. Do not circle any numbers in the line marked no group.

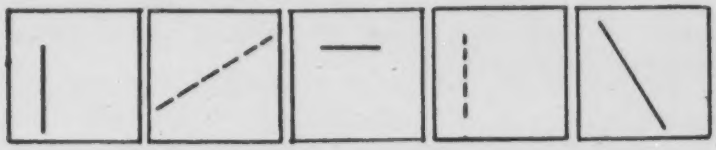
Your score will be the number of groups marked correctly minus a fraction of the number wrong.

You will have 5 minutes for each of the two parts. Each part has 10 items.

012 - FIGURE GROUP NAMING

This is a test of your ability to choose the correct name to describe how a group of figures is alike.

Look at this example:



1. All of the figures in the group above have:_____

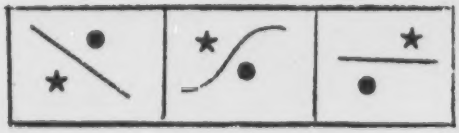
_____

How are these figures alike? Some lines are upright, some are tilted, and some are horizontal. Some lines are solid and some lines are made of dashes. But they are all straight lines.

Now try this more complicated problem. How are the figures in Group I and Group II different from each other?

Group I

Group II



2. Group I is different from Group II because Group I has:_____

_____

Group I is different from Group II because both Group I and Group II have stars, straight lines, and curved lines. But only Group I has triangles and only Group II has circles.

Your score on this test will be the number of figure groups which you name correctly. If you find it difficult to describe in words what it is that makes a group, you may make a small drawing of the kind of shape or figure that you find in the group. For example, you might have drawn: △ as the answer to example 2.

You will have 5 minutes for each of the two parts of this test. Each part has 10 items on 3 pages. When you have finished Part 1, STOP. Please do not go on to Part 2 until asked to do so.

013 - RECOGNIZING WORD GROUPS

This is a test of how often you can get the gist of an idea from five words that are connected with that idea. Each item consists merely of 5 common words. If they go together because of their meaning (not spelling, length, or sound), write a word that tells how they are alike. If the five words do not <u>all</u> go together for some reason, write "no group."

Sample item:

1. sandwich, pop, ants, outdoors, paper picnic

These words all have to do with a picinc, and so the word picnic has been written on the line beside it.

Another sample:

2. water, soap, warm, wash, towel _____

All of these words concern taking a bath, and so the words bathing or washing would be correct.

Another sample:

3. sandwich, helmet, gold, window, shoe _____

Since there is no particular association for all of these words, the answer is "no group." It would be <u>wrong</u> to suggest a very far-fetched connection.

Your score will be the number of items named correctly minus the number wrong.

You will have <u>4 minutes</u> for each of the two parts. Each part has 24 items.

031 - GESTALT COMPLETION TEST

This is a test of your ability to perceive a whole picture even though it is not completely drawn. You are to use your imagination to fill in the missing parts.

Look at each incomplete picture and try to see what it is. On the line under each picture, write a word or two to describe it.

Try the sample pictures below:

1._____ 2._____

Picture 1 is a flag and picture 2 is a hammer head.

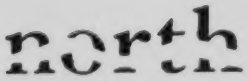
Your score on this test will be the number of pictures identified correctly. Even if you are not sure of the correct identification, it will be to your advantage to guess. Work as rapidly as you can without sacrificing accuracy.

You will have 3 minutes for each of the two parts of this test. Each part has two pages. When you have finished Part 1 (pages 2 and 3), STOP. Please do not go on to Part 2 until you are asked to do so.

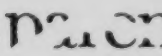
032 - CONCEALED WORDS TEST

This is a test of your ability to tell what a word is after parts of it have been erased. Look at the words printed below. The word north has been completely printed the first time; the second time parts of the letters have been erased.

north



Now look at the words below. All the words used in this test will be at least four letters long. No word will contain any capital letters. Parts of each word have been erased. Try to figure out what each word is.

 _____

_____

_____

You should have recognized the words to be parents, easy, and giant.

You will have 4 minutes for this test. Each part has two pages. When you finish Part 1, STOP. Do not go on to Part 2 until asked to do so.

Your score will be the number of correct answers that you write. Work as quickly as you can without sacrificing accuracy. If some words are difficult, skip them, and return to them later if you have time.

033 - SNOWY PICTURES

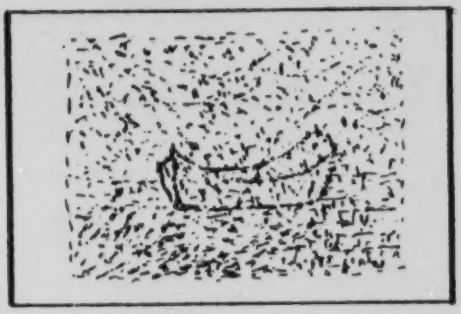
A very helpful ability is the one that enables us to see objects quickly in spite of their being partially concealed by snow, rain, haze, darkness, or other visual difficulties. This is a test of your ability to recognize hard-to-see objects.

Sample item 1:

anchor

By looking carefully at this sample you will see an anchor. The word anchor has been written on the line under the picture.

Now try another sample:



The picture shows a small boat sitting in the water. Boat, rowboat, or other similar words would be correct answers.

You will have 4 minutes for each of the two parts of this test.

Do not go on to Part 2 until asked to do so.

041 - SCRAMBLED WORDS

This is a test of your ability to unscramble a group of letters and make a word out of them.

Look at the groups of letters below. If they are unscrambled, each group will spell a common English word.

I) eboy
II) vyne
III) toha

The first group spells obey when it is unscrambled. The second group spells envy; and the third group spells oath.

Now try the practice items below. Circle the first letter of the word that can be made by unscrambling the letters. Remember that you must use all of the letters of the scrambled word.

Scrambled word:

IV) tyci
V) homw
VI) lanp
VII) uder

You should have circled c for IV; w for V; p for VI; and r for VII. The words are city, whom, plan, and rude.

Your score on this test will be the number of words that you unscramble correctly. Therefore, it will not be to your advantage to spend a lot of time on a hard word. Remember that all of the unscrambled words are common English words; proper names (of people and places) are not used.

You will have 5 minutes for each of the two parts of this test. Each part has one page with 25 words. Do not spend too much time on any one word. When you have finished Part 1, STOP. Please do not go on to Part 2 until asked to do so.

043 - HIDDEN WORDS

This is a test of your ability to find words that are hidden in a line of letters.

Look at the example below:

E P N Z O (F O U R) E Q W (L O C K) I C Z K E T (M I N D) I M S F Y

I R T N U Y (S H I P) I M S A F Y V (P U L L) O T (F I V E) (B E L T)

A circle has been drawn around each group of four consecutive letters that spell a common English word. The same letter can be used in only one word; that is, the words cannot overlap. Only four-letter words are used in this test. There may be one, two, three, four, or five words in a line.

Read each row from left to right. Draw a circle around each group of four letters that spells a common English word. Now try the practice items below.

1. D O O R L O D E I D X U J Q Z V H E A D I P S C A G M I N E K

2. L T R E Q A B I R D P Q A W A N T E T F O U S A I D Z R O V L

You should have found the words DOOR, LODE, HEAD, MINE in the first line and BIRD, WANT, SAID in the second line.

Your score on this test will be the number of four-letter words which you find. Proper names (of people and places) will not be used.

You will have 4 minutes for each of the two parts of this test. Each part has one page with 20 lines of letters. When you have finished Part 1, STOP. Please do not go on to Part 2 until asked to do so.

044 - INCOMPLETE WORDS

This is a test of your ability to complete words when some of the letters are missing.

Look at the example below:

h__art

You could put the letter "e" in the blank and make the word heart. Now look at this example which has two letters missing:

co__fortab__e

You can make the word comfortable by putting an "m" in the first blank and an "l" in the second blank.

Sometimes it might be possible to use any one of several different letters to complete a word. For example:

l__mp

could be completed by adding an "a" to make the word lamp, or an "i" to make the word limp, or a "u" to make the word lump.

Now try these practice items. In each blank, write one letter. When a word has more than one blank, each blank has its own number.

de___k I	bre___d IV
wi___dow II	b___lge V
f___sh III	an___m___l VI VII

You could have made the words desk, window, fish, bread, bulge, and animal out of the practice items.

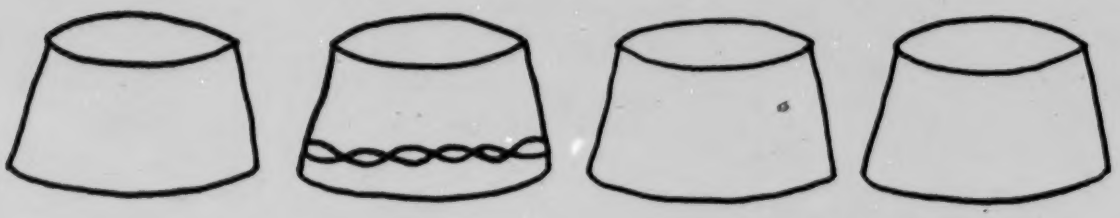
Your score on this test will be the number of words that you complete correctly.

You will have 3 minutes for each of the two parts of this test. Each part has one page with 18 words to complete. Do not spend too much time on any one word. When you have finished Part 1, STOP. Please do not go on to Part 2 until asked to do so.

071 - ORNAMENTATION TEST

This is a test of your ability to think of as many different ways as possible to decorate an object.

Look at the sample below. The first picture shows a plain lampshade. The second shows the same lampshade after a design has been added to it. Can you think of two more designs for the other two lampshades?



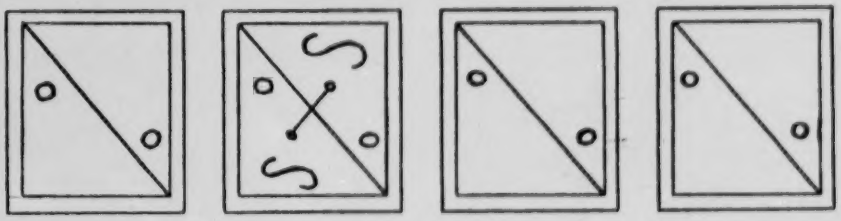
The decorations you put on objects in this test can be of any type, but each must be different. Random marks or scribbles will not be considered as designs. Each decoration can be as simple or as complicated as you choose. However, your score on this test will be the number of different designs you make. Therefore, it will not be to your advantage to spend too much time on any one design.

This test has two parts. Each part asks you to ornament a different object. You will have 2 minutes for each part. When you have finished Part 1, STOP. Do not go on to Part 2 until asked to do so.

072 - ELABORATION TEST

This is a test of your ability to think of a number of different ways to add details to a design.

Look at the sample below. The first picture shows the original design on a playing card. The second picture shows one possible way to add to that design. Can you think of some others?



The material you add to each design can be whatever you wish, but each must be different. Random marks or scribbles will not be considered designs.

Each decoration can be as complicated as you choose. However, your score on this test will be the number of different designs to which you have added something. Therefore, it will not be to your advantage to spend too much time on any one design.

This test has two parts. Each part asks you to add to the design on a different object. You will have 3 minutes for each part. When you have finished Part 1, STOP. Do not go on to Part 2 until asked to do so.

073 - SYMBOLS TEST

This is a test of your ability to think up a number of different symbols that could be used to stand for certain words or ideas.

Look at the example below. The word is food. A sketch has been made to represent a fork and spoon. Can you think of other symbols that could represent food? Draw them in the boxes.

Food:

Your score on this test will be the number of different symbols you produce. Therefore, you should not spend too much time on any one symbol or set of symbols.

You will have 5 minutes.

111 - CALENDAR TEST

This is a test of your accuracy in following directions. Each direction will ask you to find a date on a calendar.

In this calendar you are to remember that:

1. A circled number is a holiday
2. Saturdays and Sundays are weekend days
3. All days except holidays and weekends are work days
4. The first day of Spring is March 21
5. The first day of Summer is June 21
6. The first day of Fall is September 21
7. The first day of Winter is December 21

Look at the sample items below. Put an x on the letter in front of the correct answer.

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	(11)	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

I. What is the third Tuesday of the month?
a. 15th b. 17th c. 22nd d. 24th e. Not given

II. What is the third working day after the holiday?
a. 13th b. 14th c. 15th d. 16th e. Not given

III. What is the seventh working day after the third Monday of the month?
a. 9th b. 27th c. 29th d. 30th e. Not given

The answers are I, a; II, d; III, d.

Your score will be the number of dates you mark correctly minus a fraction of those marked incorrectly. Therefore, it will not be to your advantage to guess unless you have some idea about which date is correct.

This test has two parts. Each part has 10 dates for you to select. You will have 5 minutes for each part.

When you have finished Part 1, STOP. Please do not go on to Part 2 until asked to do so.

112 - FOLLOWING DIRECTIONS

This is a test of your ability to follow a set of directions. You will be given a pattern of letters to look at and will be asked questions about how certain directions will change that pattern. The answer to each question will be one of the letters in the pattern. You are to decide which letter is correct and draw a circle around that letter.

Look at this example:

	Column			
	1	2	3	4
Row 1	A	B	C	D
Row 2	D	A	B	C
Row 3	C	D	A	B
Row 4	B	C	D	A

I. What letter always appears directly above the letter A?

A B C D

II. If one letter occurs more frequently than another, the answer is the most frequently occurring letter; if not, the answer is the letter in the upper left to lower right diagonal.

A B C D

You should have circled B for I and A for II.

This test has two parts. Each part has 10 items. You will have 7 minutes for each part. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Your score on this test will be the number of directions which you follow correctly minus a fraction of those incorrect. Therefore it will not be to your advantage to guess unless you are fairly certain what you are supposed to do.

113 - LANGUAGE RULES

This test will show you whether you can keep in mind (or quickly look up) those many, many new rules and new words that you have to use when you learn a new language or learn any new set of complicated operations.

This test has its items right in with the directions. You will read some directions, get some items to answer, and then you will get more directions and more items. They will get more and more complicated because, for the last item, you will need to use all the directions at once. You can look back at any of the directions, but it will help to remember some of them.

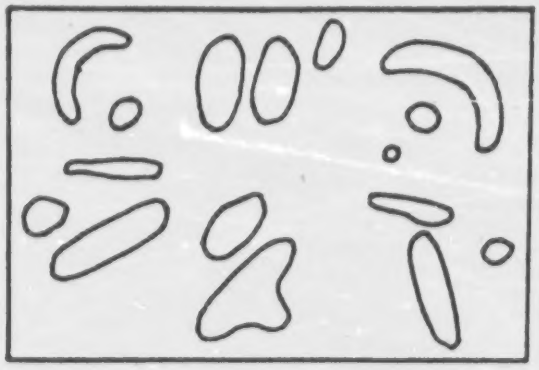
You will have 8 minutes for each of the two parts. You will mark each answer by putting an x on the letter in front of the correct answer.

141 - SHAPE MEMORY TEST

This is a test of your ability to remember a group of shapes and their positions in relation to each other.

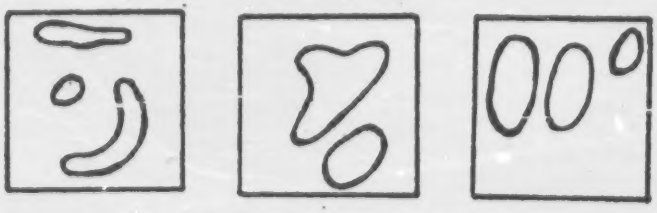
You will be given a picture to study. After you have had some time to learn the shapes and their orientation, you will be asked to turn to a test page which will show some of the same shapes that you studied. For each picture on the test page you will be asked whether it is the same as the one in the study picture or whether it is different from those you studied.

Now look at this sample:



For each sample item, blacken the space beside the Y (Yes) if the item shows part of the picture you studied, and N (No) if the picture is not one you studied.

I. II. III.



Y= N= Y= N= Y= N=

You should have blackened the space with Y on the answer sheet for item I, N for item II, and Y for item III. Remember the test items will show only a small part of the picture that was studied. Blacken the space beside Y for items that show the same shapes in the same orientation as on the study picture. Blacken the space beside N for items that show different shapes.

Your score on this test will be the number of items you mark right minus the number wrong. Therefore, it will not be to your advantage to guess if you are unsure about an answer.

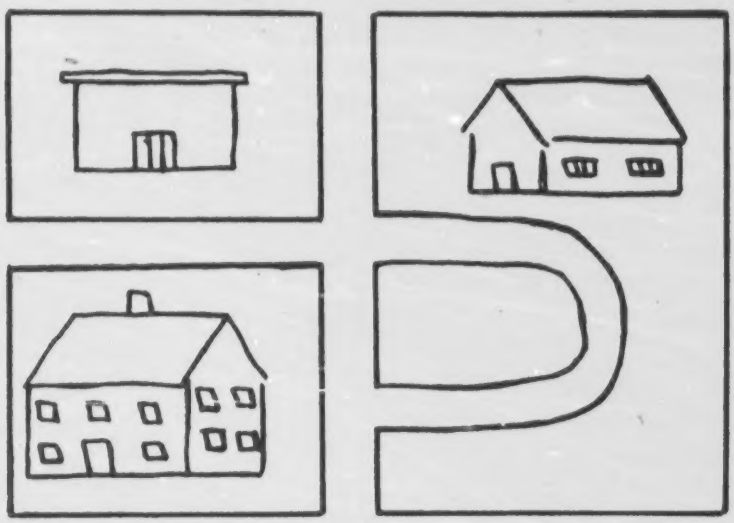
There are two sections for each part of this test. The first of these is a study picture which will be projected for you to study for 4 minutes. The second part is the test section and contains 16 items. You will have 4 minutes to mark your answers. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

142 - BUILDING MEMORY

This is a test of your ability to remember the position of structures on a street map.

You will be given a map with streets and buildings or structures to study. After you have had some time to learn the street layout and the different kinds of structures, you will be asked to turn to a test page. On that page you will find the street map and numbered pictures of some of the structures. You will be asked to indicate on your answer sheet what letter is written where each of the structures belong.

Now look at this simple but enlarged sample:



After you have studied the sample above for about a minute, turn to the next page.

Look at the numbered houses on the left. For each item, darken the space under the letter that occurs where each house was located on the study map.

1.

A B C D E

= = = = =

2.

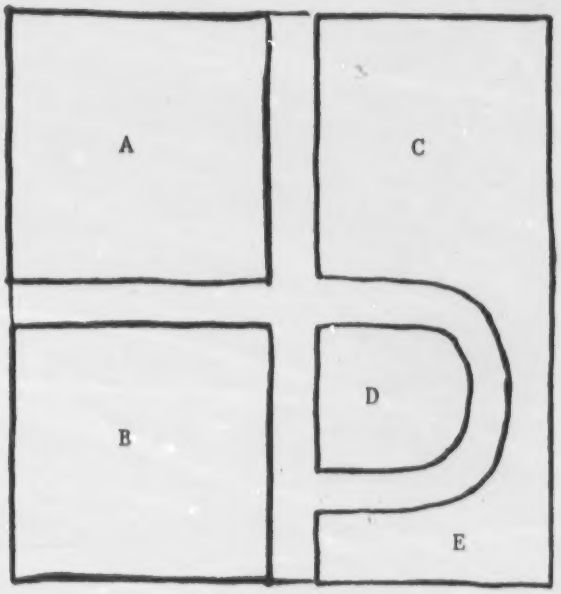
A B C D E

= = = = =

3.

A B C D E

= = = = =



Your answers for sample items 1, 2, and 3 should be A, C, and B, respectively.

Your score on this test will be the number of buildings placed correctly minus a fraction of the number wrong. Therefore, it will not be to your advantage to guess.

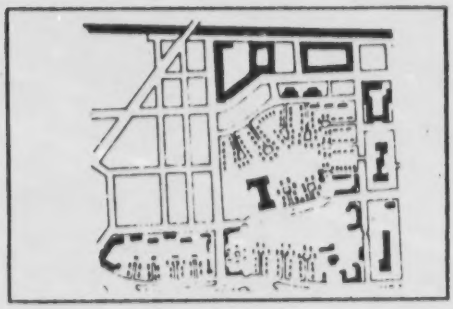
There are two parts to each section of this test. The first is a map which will be projected for you to study for 3 minutes. The second is the test section and contains 15 structures to be located on the map. You will have 4 minutes to mark your answers on the answer sheet. Mark A, B, C, D, or E for each building. In the test section, the buildings will be mixed up and not necessarily near the part of the map where you first saw them.

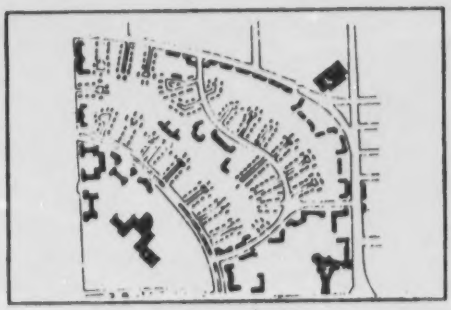
When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

143 - MAP MEMORY

This is a test of your ability to remember part of a map so that you can recognize it when you see it again.

Study the sample item below. You have 1 minute.

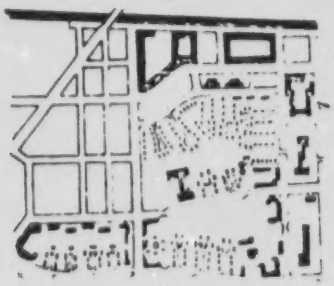




Now turn the page.

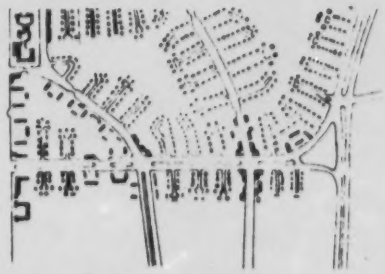
Which two of these four maps are part of those you saw on the study page? Mark the Yes box beneath the maps you studied. Mark the No box beneath the maps you have not seen before.

a.



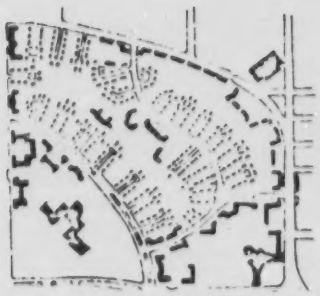
Yes ☐ No ☐

b.



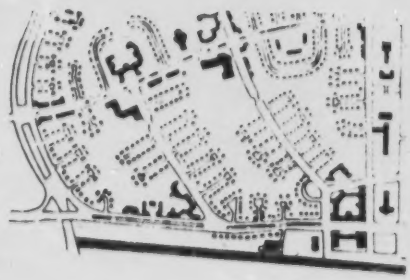
Yes ☐ No ☐

c.



Yes ☐ No ☐

d.



Yes ☐ No ☐

You should have marked Yes under maps a and c, No under maps b and d.

Each of the two parts of this test will have a study page which will be projected for you to look at for 4 minutes and two memory pages for which you will have 3 minutes.

Your score will be the number of maps which you identify correctly minus the number which you identify incorrectly. Therefore, it will not be to your advantage to guess unless you have some idea of whether or not you have studied the map.

153 - SUBTRACTION AND MULTIPLICATION TEST

This is a test to see how quickly and accurately you can subtract and multiply. It is not expected that you will finish all the problems in the time allowed.

You are to write your answers in the boxes below the problems. Several practice problems are given below with the first one correctly worked. Practice for speed on the others. This practice may help your score.

Practice Problems:

Subtract:

98	40	37	84	81	76	59	90	46	56
-75	-35	-19	-47	-38	-40	-46	-31	-29	-23
23									

Multiply:

86	67	30	81	42	37	81	86	43	69
x 6	x 4	x 3	x 8	x 5	x 8	x 4	x 3	x 6	x 7
516									

Your score on this test will be the number of problems solved correctly. Work as rapidly as you can without sacrificing accuracy.

You will have 2 minutes for this test.

154 - ALPHABET DISTANCE SPEED

Some people are fast with numbers; some are fast with letters. In either case the trick is to concentrate hard on what you are doing. Try for speed on these counts of letters in the alphabet. Practice now saying the alphabet a couple of times very fast.

The items are given on the answer sheet. Each item gives two letters with a dash between them.

Sample item: C - F 1 2 3 4 5

This asks you to count the letters in the alphabet including C and F and all letters between them. Say each letter to yourself while looking at each answer box. Starting at the first number, the 1, with C, you would come to F at the number 4. That is the answer, because there are four letters. Therefore, you would circle the 4.

It does not matter how often you get to 5 in making your count, and so you can start in again at box 1 after counting each 5. This is like counting on the fingers of one hand.

Another sample: E - S 1 2 3 4 5

Starting with E at Box 1, you would say the alphabet as far as S while looking at all of the boxes several times and you would find that S falls on box 5. Therefore, you would circle number 5.

Now get ready to do this as fast as you can.

You will have 2 minutes for each of the two parts.

155 - ADDITION AND SUBTRACTION CORRECTION

This will try out your ability and speed at adding and subtracting 2-digit numbers. You may use this sheet for scratch paper, but you will probably move along faster if you solve the problems in your head, because they are not very hard.

For each item, two numbers are given to be added or subtracted according to the sign between them (+ or -). In all cases an answer is suggested. If the suggested answer is correct, blacken the space in the column headed "C" for correct. If the suggested answer is not correct, blacken the space in the column headed "I" for incorrect.

Sample problems:

		C	I
1.	11 + 23 = 34	⬭	⬭
2.	20 - 17 = 3	⬭	⬭
3.	35 - 10 = 20	⬭	⬭

You would blacken the first space marked C (correct) for problems 1 and 2, because 11 added to 23 is 34, and 20 minus 17 is 3. For problem 3 you would blacken the I (incorrect) space, because 35 minus 10 is 25, not 20.

Your score on this test will be the number of items marked correctly minus the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you have some idea about the correct answer.

You will have 2 minutes for each part. There will be more items than you can finish.

181 - MATHEMATICS APTITUDE TEST

In this test you will be asked to solve some problems in mathematics. Solve each problem and put an x on the letter in front of the answer that you select.

Example:

How many pencils can you buy for 50 cents at the rate or 2 for 5 cents?

A - 10

B - 20

C - 25

D - 100

E - 125

Your score on this test will be the number marked correctly minus a fraction of the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you are able to eliminate one or more of the answer choices as wrong.

You will have 10 minutes for this test.

183 - DECIPHERING LANGUAGES

An archeologist who discovers small fragments of some ancient language must do a lot of reasoning to put the language together. This is a test of your ability to do this kind of reasoning.

For each different artificial language, three expressions in English and then translations into the language are given. From these you will need to figure out logically which syllable or which symbol in the language is equivalent to which English word. Note that the order of the symbols is consistent for any language, but may be different in each language and different from English. Make an x on the number of the correct answer.

In each of the two parts there are three different make-believe languages to be deciphered. The first and second are each followed by three multiple-choice items; the third is followed by six items. This makes a total of 12 items in each of the two parts. You will have 8 minutes for each part.

184 - NECESSARY ARITHMETIC OPERATIONS TEST

This test consists of problems in mathematics. However, instead of solving the problems and finding an answer, your task will be merely to indicate which arithmetic operations could be used, if you solved the problems. Put an X through the number in front of the option that you select.

Example I

If a man earns $2.75 an hour, how many hours should he work each day in order to make an average of $22.50 per day?

1 - subtract
2 - divide
3 - add
4 - multiply

In order to solve the problem you should divide $22.50 by $2.75; therefore, you should have put an X through 2.

Example II

Desks priced at $40 each are being sold in lots of 4 at 85% of the original price. How much would 4 desks cost?

1 - divide and add
2 - multiply and multiply
3 - subtract and divide
4 - multiply and divide

One way to solve the problem would be to multiply $40 by .85 and then multiply this product by 4; therefore, you should have put an X through number 2. (Although some problems may be solved in more than one way, as with Example II, only the operations for one of these ways will be given among the options.)

When two operations are given, they are always given in the order in which they should be performed.

Your score on this test will be the number marked correctly minus a fraction of the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you are able to eliminate one or more of the answer choices as wrong.

You will have 5 minutes for this test.

201 - NONSENSE SYLLOGISMS TEST

This is a test of your ability to tell whether a conclusion shows good or poor reasoning. Although all of the statements are really nonsense, you are to assume that the first two statements in each item are correct. The conclusion drawn from these two statements may show good or poor reasoning. If the conclusion shows good reasoning, mark the box under the G. If the conclusion shows poor reasoning, mark the box under the letter P.

Now look at these examples:		G	P
a) All trees are fish. All fish are horses. Therefore, all trees are horses.	a.	■	
b) All trees are fish. All fish are horses. Therefore, all horses are trees.	b.		■

Example a) shows good reasoning so box G has been marked beside the a; example b) shows poor reasoning so box P was marked for it.

Now try these practice items:

c) Some swimming pools are mountains. All mountains like cats. Therefore, all swimming pools like cats.	c.		
d) All swimming pools are mountains. All mountains like cats. Therefore, all swimming pools like cats.	d.		
e) All elephants can fly. All giants are elephants. Therefore, all giants can fly.	e.		
f) Some carrots are sports cars. Some sports cars hop. Therefore, some carrots hop.	f.		
g) No two flowers look exactly the same. Roses and tulips look exactly the same. Therefore, roses and tulips are not two flowers.	g.		

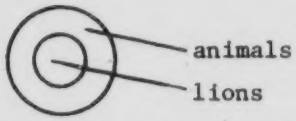
Did you mark P for item c, G for item d, G for item e, P for item f, and G for item g?

Your score on this test will be the number of items answered correctly minus the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you have some idea of whether the reasoning is good or poor.

You will have 4 minutes for this test.

202 - DIAGRAMMING RELATIONSHIPS

Sometimes the relationships among groups of things are best explained by diagrams that consist of overlapping circles. For example, if certain specific things, let's say lions, all belong to one larger class of things, let's say animals, you could diagram the situation as follows:



In these diagrams, we do not care about the relative sizes of any of the circles. That is, we are not suggesting here that a relatively large proportion of animals are lions, but we are indicating that <u>all</u> lions are animals. That is why the circle representing lions is drawn entirely within the circle that represents animals.

Now that the relationships among three groups of different things: birds, pets, and trees. These should be diagrammed as follows:

This diagram shows that <u>no</u> trees are <u>either</u> pets <u>or</u> birds, but <u>some</u> birds are pets and <u>some</u> pets are birds.

Each item in this test names three groups of things. You are to choose from the letter diagrams at the top of the test pages the one diagram that shows the correct relationships among the three groups of things in each item. Write the letter of the diagram that you select.

Your score on this test will be the number of correct choices minus a fraction of the number of incorrect choices. Therefore, it will <u>not</u> be to your advantage to guess, unless you have at least some idea that will help you make a correct choice.

There are two parts to this test. For each part you will have <u>4 minutes</u> to complete 15 problems.

204 - LETTER GROUP REASONING

In this test you will be asked to evaluate as "True" or "False" some conclusions that have been drawn from data that are given to you. For each set of six items, the data consist of three groups of letters. Read each conclusion and decide whether or not it follows the data.

Sample Data:

Group I is A B C D E F G

Group II is F G H I J

Group III is A B C D E

Sample Items:	T	F
A. All III is I	—	—
B. Some II is III	—	—

Item A should be marked "True" because all of the letters in Group III are in Group I; that is, all of Group III is part of Group I. Item B should be marked "False" because none of the letters in Group II are in Group III; no part of Group II is a part of Group III.

Each of the two parts has four sets of data, each set having six conclusions to be evaluated. For conclusions that are "True," blacken the space under "T". For conclusions that are "False," blacken the space under "F".

Your score on this test will be the number of items marked correctly minus the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you have some idea about the correct answer.

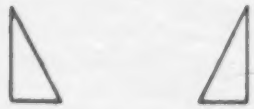
You will have 5 minutes for each part.

211 - CARD ROTATIONS TEST

This is a test of your ability to see differences in figures. Look at the 5 triangle-shaped cards drawn below.

All of these drawings are of the same card, which has been slid around into different positions on the page.

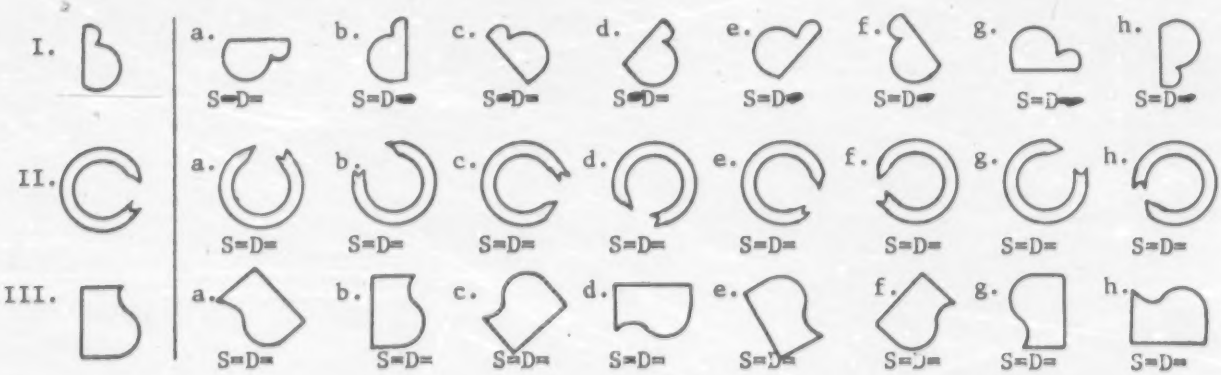
Now look at the 2 cards below:



These two cards are not alike. The first cannot be made to look like the second by sliding it around on the page. It would have to be flipped over or made differently.

Each problem in this test consists of one card on the left of a vertical line and eight cards on the right. You are to decide whether each of the eight cards on the right is the same as or different from the card at the left. Mark S (same) if the card is the same as the one at the beginning of the row. Mark D (different) if it is different from the one at the beginning of the row.

Practice on the following rows. The first row has been correctly marked for you.

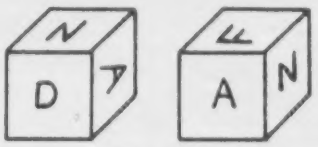


Your score on this test will be the number of items marked correctly minus the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you have some idea whether the card is the same or different. Work as quickly as you can without sacrificing accuracy.

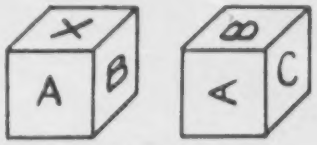
You will have 4 minutes for this test.

212 - CUBE COMPARISONS TEST

Wooden blocks such as children play with are often cubical in shape and have a different letter or number on each of their six faces (top, bottom, and four sides). Each problem on the test consists of drawings of two cubes of this kind. Look at the two pairs of cubes below:

I. 

S=D=

II. 

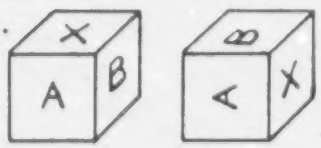
S=D=

The first pair of cubes is different. The D has been marked because the two drawings must be of different cubes. If the left cube is turned so that the A is in front, the N on this cube will be hidden and will be on the side opposite where it is shown on the right-hand cube.

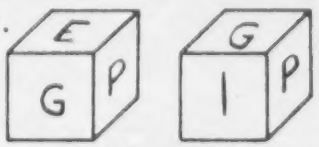
The second pair of drawings can represent the same cube. When the left cube is rolled over to the left, the X will no longer show, a C will appear, and the cubes can be the same. The S has been marked on your answer sheet.

RULE: When a face is hidden on one cube and is turned up on the second, the letter or number on that face is correct unless that letter or number has already been shown in a different position on either of the cubes.

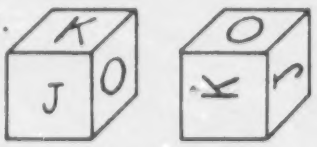
Be sure you see that this pair can represent the same cube.

III. 

S=D=

IV. 

S=D=

V. 

S=D=

Example III should be marked "different" because X cannot be next to the top of A on the left cube and the bottom of A on the right cube. Example IV is "different" because P has its side next to G on the left cube and its top next to G on the right cube. Example V is "same."

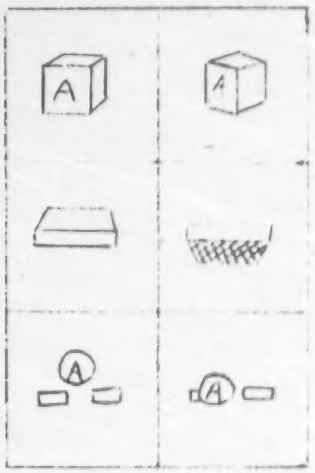
Your score on this test will be the number marked correctly minus the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you have some idea which choice is correct. Work as quickly as you can without sacrificing accuracy.

You will have 3 minutes for this test.

213 - SPATIAL ASPECTS

Objects look differently to you when you change your own position. In this test each item presents two sketches of the same object or objects. Compare the two sketches and decide in what directions (up, down, right, left) you must have moved, so that the object or objects change from their looks in the first (left-hand) sketch to the way they look in the second sketch.

Here are three sample items:



	UP	SAME	DOWN	RIGHT	SAME	LEFT
1.						
2.						
3.						

You should mark two answers for each item. In order to make the first picture look like the second do you have to move:

1.	UP	and also:	1. to the RIGHT
2.	stay at the SAME level	"	2. stay at the SAME level
3.	DOWN	"	3. to the LEFT

In sample 1, above, you see about the same amount of the top of the cube, and so you must be staying at the SAME level. However, you must move to the RIGHT in order to see the corner pointing straight toward you. Your answer, then is SAME-RIGHT.

In sample 2 above, you are directly facing the end or side of a flat piece of wood. In the second picture you still face it directly, but you see the bottom (cross hatched) instead of the top. Therefore, you must have moved DOWN, but are at the SAME angle.

NOTE: To avoid ambiguity in some sketches, the lower sides of objects are shaded by cross-hatching.

In sample 3, three objects are seen in space. A move UP makes the round figure look relatively lower, since it is closer, as is easily seen in the second sketch. The round figure also appears to be farther to the left. Since it is closer, this requires a move to the RIGHT.

Your score on this test will be the number of choices (two for each item) marked correctly minus a fraction of the number marked incorrectly. Therefore, it will not be to your advantage to guess unless you have some idea about the correct answer.

You will have 4 minutes for each of the two parts. Each part has 20 items. This means that you will have to move along as fast as you can.

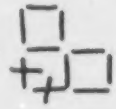
261 - TOOTHPICKS TEST

In this test you will be asked to make patterns of squares using toothpicks. You will be given a pattern of squares and asked to change it by removing some of the toothpicks. You can show which toothpicks are to be removed by drawing a short line through them. Look at the example below:

Take away 2 toothpicks
Leave 2 squares

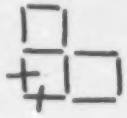
To show this:

You mark like this:

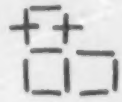


Whenever you make a pattern it must have complete squares with no extra toothpicks left over. The example below shows a correct pattern and an incorrect pattern with a toothpick which is not a part of any square.

Take away 2 toothpicks
Leave 2 squares



Correct



Incorrect

Sometimes it is possible to make both large and small squares or to make overlapping squares.

You will be asked to think of several different solutions for each item in this test. In some problems you will be told both how many toothpicks to remove and how many squares to leave; some problems tell you only how many squares to leave. Each answer that you give for an item must be a new pattern, based on a different rule or principle, and not just the same answer turned around or turned over.

Your score on this test will be the number of correct solutions to each item using different rules.

You will have 5 minutes for this test.

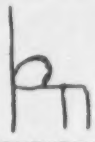
262 - DRAWING ASSEMBLY TEST

In this test you will put together certain given lines, so as to produce drawings that can be recognized as different objects. Little or no drawing ability is needed, but you will need to think of a lot of different objects and their names.

For each of the two parts of this test you will be given a set of lines. Construct or draw as many different objects as you can with these lines and name each object. No two names can be the same, and more than one drawing of the same object does not count.

Sample:

Draw as many different objects as you can with 4 straight lines (any length) and one circle (any size), and write the name of each object under it. You might proceed as shown below. Three objects are given. Go ahead and try some more, but do not include another table, chair and pillow, or face.

			
Table	Chair and pillow	Face	

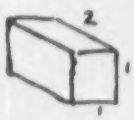
Your "drawings" need not be "good." They should merely be recognizable as the objects that you name.

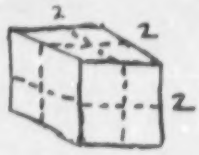
Work as rapidly as you can. Your score will be the number of recognizable different objects that you draw and name. You will have 4 minutes for each of the 2 parts of this test.

263 - STORAGE TEST

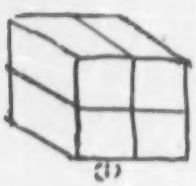
In this test you will be asked to plan how objects can be stored in a given space. You will be asked to think of as many different ways as possible to arrange the objects in this space.

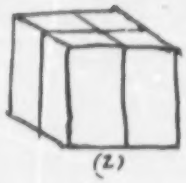
How many different ways can 4 boxes, like the one on the left below, be stored in the container shown on the right? The numbers on the sides of the figures and the dotted lines are to help you compare sizes.

Box: 

Container: 

The drawings below show three correct solutions to this problem. Note that drawings (1) and (2) use the same rule. The rule is that all of the square ends of the boxes are on the same face of the cube. Drawing (3) uses a different rule.


(1)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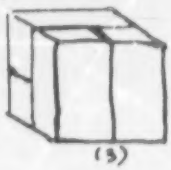
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